

REMARKS

Reconsideration of the application as amended is respectfully requested.

The Examiner's communication dated 05/14/2007, which includes making the election requirement final, is acknowledged.

Claims 1 – 64 are pending in the application. Of these, claims 6, 8, 10 – 15, 18 – 27, and 42 – 64 are withdrawn from consideration under the various previous restriction and election requirements as updated in the office action dated 05/14/2007. Claims 1 and 36 – 41 are objected to. Claims 1 – 4, 5, 7, 9, 16 – 17, and 28 – 41 stand rejected under 35 USC §112. Claims 3 and 38 stand rejected under 35 USC §102. Claims 1 – 5, 7, 9, 16, 17, and 28 – 41 stand rejected for obviousness under 35 USC §103. Previous indications of allowable subject matter by the previous examiner have now been withdrawn by the current examiner.

By the present amendment, claims 1 and 36 are amended. After this amendment, claims 1 – 64 are pending in the application, and claims 6, 8, 10 – 15, 18 – 27, and 42 – 64 remain withdrawn from consideration.

Basis for the insertions in claims 1 and 36 is found in the original specification as filed at page 3 lines 14 – 17, page 6 lines 25 – 27, and in drawing FIG. 5A (step S60).

Objections to the claims

Claims 1 and 36 are objected to because of the “abbreviations (i.e. MEMS).” The claims are to be interpreted in the light of the specification. The acronym “MEMS” is clearly defined explicitly in the specification as filed on page 3, which recites: “The term ‘MEMS’ has its conventional meaning of a micro-electro-mechanical system. The prefix ‘micro-’ and the term ‘microscale’ refer to structures having minimum dimensions of the order of about one micrometer.” Furthermore, the term “MEMS” has acquired status as a well-known term of the art, such that a person skilled in the art would

immediately understand its meaning. Witness the numerous issued patents since at least the last ten years, whose claims and specifications include the term "MEMS." Therefore, Applicants respectfully submit that the Examiner's objection to the acronym "MEMS" is unwarranted. Nevertheless, claims 1 and 36 have been amended as required by the Examiner.

Claims 36 – 41 are objected to because their status identifier needed to be changed. Accordingly, the status identifiers of these claims have been changed to "Original" if they have not been amended or to "Currently amended" if they are currently amended.

Rejections under 35 USC § 112 traversed

Claims 1 – 5, 7, 9, 16 – 17, and 28 – 41 stand rejected under 35 USC §112, second paragraph, as being indefinite. These rejections are respectfully traversed.

Regarding claims 1 and 36, the Examiner states both that essential steps have been omitted, amounting to a gap between the steps, and that essential structural cooperative relationships have been omitted. Applicants respectfully disagree that any essential steps have been omitted or that any essential structural cooperative relationships have been omitted. Claim 1 as amended recites: "A fabrication method for a micro-electro-mechanical system (MEMS)-based fuel cell using a fuel and an oxidant, the method comprising the steps of:

- a) providing a substrate;
- b) depositing an electrolyte upon the substrate;
- c) depositing and patterning a cathode in contact with the electrolyte;
- d) depositing and patterning an anode spaced apart from the cathode and in contact with the electrolyte; and
- e) forming a chamber extending over at least a portion of at least one of the cathode and anode, the chamber including at least one integral manifold for at least one of the fuel and oxidant."

FIG. 5A shows a complete set of steps performed in accordance with claim 1 and its dependent claims. FIGS. 2A – 2D, 3A – 3B, and 4A – 4B show examples of the structures at various stages of the fabrication method, and FIGS. 1A – 1B show a unit cell of a fuel-cell embodiment made by the method embodiment of claim 1. The Examiners assertion (page 5 paragraph 11) that one side of the electrolyte would be available for contacting either the anode or the cathode, but not both, is not correct, as shown by Applicants' drawings. FIGS. 1A and 1B clearly show both cathode 40 and anode 50 on the same side of electrolyte 30 and both simultaneously in contact with electrolyte 30. In the particular embodiment illustrated in FIG. 1A, the cathode 40 and anode 50 are interdigitated when patterned in steps c) and d) respectively of claim 1 and the patterning of anode 50 spaces the anode 50 apart from the cathode 40 as recited in step d) of claim 1.

Furthermore, the substrate recited in claims 1 and 36 may itself comprise an electrolyte (specification page 4 lines 6 – 8 and claims 21 and 22, for example). In such embodiments of the methods of claims 1 and 36, contrary to the Examiner's assertion, *both sides of the electrolyte* are available for depositing and patterning the cathode 40 as recited in claim 1, step c) and *both sides of the electrolyte* are also available for depositing and patterning the anode 50 as recited in claim 1, step d).

The same reasoning applies to claim 36 as amended, which recites: "A fabrication method for a micro-electro-mechanical system (MEMS)-based fuel cell using a fuel and an oxidant, the method comprising the steps of:

- a) providing a substrate;
- b) depositing an electrolyte upon the substrate;
- c) depositing and patterning a cathode in contact with the electrolyte;
- d) depositing and patterning an anode spaced apart from the cathode and in contact with the electrolyte;
- e) forming a first chamber extending over at least the anode, the first chamber including an integral manifold for the fuel;

- f) forming a second chamber extending over at least the cathode, the second chamber including an integral manifold for the oxidant;
 - g) removing at least a first portion of the substrate under the anode and cathode, leaving a thinner second portion forming a membrane portion;
 - h) forming a first opening through the substrate under the first chamber, the first opening communicating with the first chamber, whereby the first opening is adapted for flow of fuel into the first chamber; and
 - i) forming a second opening through the substrate under the second chamber, the second opening communicating with the second chamber, whereby the second opening is adapted for flow of oxidant into the second chamber."
- The pertinent steps c) and d) of claim 36 are identical with the corresponding steps of claim 1, and thus, are equally clear.

Regarding claim 7, the Examiner asserts that "suitable" is a relative term which renders the claim indefinite. Claim 7 recites (emphasis added): "The method of claim 1, wherein the chamber-forming step e) comprises the substeps of:

- i) depositing a layer of sacrificial material;
- ii) patterning the sacrificial material;
- iii) covering the sacrificial material with *a suitable material to form a chamber roof*, and
- iv) removing the sacrificial material."

The term "*a suitable material to form a chamber roof*" is to be construed in the light of the specification, which recites in pertinent part (emphasis added) (page 7 lines 19 – 26): "Some *suitable materials to form the chamber roof* for various embodiments are silicon oxide, silicon nitride, silicon oxynitride, silicon carbide, aluminum oxide, spin-on-glass (SOG) compounds, polyimides (e.g., for low temperature cells), other photopolymer systems, and the actual fuel cell electrolyte material itself. A suitable photopolymer for some embodiments is a negative, epoxy-type, near-UV photoresist based on EPON™ (e.g., SU-8, available from MicroChem Inc. of Newton, MA). Thus, a

suitable material to form the chamber roof may be an electrolyte or a non-electrolyte." Thus, contrary to the Examiner's statement, the specification does provide a standard of what is a suitable material. Applicants respectfully submit that a person skilled in the art would be able to select a material from among materials in this description and their equivalents. Thus, there is nothing indefinite about the use of "suitable material to form a chamber roof " in claim 7.

Regarding claim 41, the Examiner states that the language "at least part of the membrane portion" is a relative term which renders the claim indefinite. Claim 41 as amended recites: "The method of claim 36, wherein at least part of the membrane portion is removed so as to leave the membrane portion cantilevered." Parent claim 36 as amended recites in pertinent part (emphasis added): "(g) removing at least a first portion of the substrate under the anode and cathode, leaving a *thinner second portion forming a membrane portion*". Thus, the "membrane portion" of claim 41 is clearly identified as the thinner second portion remaining after the first portion of the substrate is removed in parent claim 36. Thus, Applicants respectfully submit that the amendment of parent claim 36 has corrected any indefiniteness of claim 41.

For all these reasons, therefore, Applicants respectfully request that the rejections under 35 USC §112, second paragraph of claims 1 and 36 and their dependent claims 2 – 5, 7, 9, 16 – 17, 28 – 35, and 37 – 41 be withdrawn.

Rejections under 35 USC § 102 traversed

Claims 3 and 38 stand rejected under 35 USC §102(e) as anticipated by Jankowski et al., 2003/0039874. These rejections are respectfully traversed. The Examiner correctly states that claims 3 and 38 are to be construed as product-by-process claims. However, in comparing the structure of the MEMS-based fuel cell (e.g., FIGS. 1 – 3) of Jankowski et al. with the structures formed by Applicants' claims 3 and 38, Applicants respectfully note that Jankowski et al. does not disclose every limitation of the invention claimed by Applicants. For example, both parent claims 1 and 36 recite in

pertinent part "providing a substrate." The structures described by Jankowski et al. in FIGS. 1 – 3 and the corresponding text require three different substrates **11**, **14**, and **16**, which serve different purposes. The Examiner has mistakenly interpreted fuel inlet **15** and oxidant inlet **17** as "chambers." Neither of these inlets is a "chamber" as claimed in Applicants' claim 1 in which the chamber *includes the limitations* of "extending over at least a portion of at least one of the cathode and anode" and "including at least one *integral manifold*". The first and second chambers of Applicants' claim 36 *have similar limitations* of "extending over at least the cathode" and "extending over at least the anode" and respective integral manifolds which are not disclosed by the fuel inlet **15** and oxidant inlet **17** of Jankowski et al., interpreted as "chambers" by the Examiner. Furthermore, in describing FIG. 3 in paragraph [0033], Jankowski et al. makes a clear distinction between the membrane-electrode assembly **41** and the micromachined substrate-manifold assembly **42**. Thus, Jankowski et al. does not disclose a "chamber including at least one *integral manifold*" as claimed in parent claim 1 of the product-by-process claim 3. Similarly, Jankowski et al. does not disclose either of the first and second chambers, each including an *integral manifold*, of parent claim 36 of the product-by-process claim 38.

Thus, since Jankowski et al. does not disclose every limitation of the claims, withdrawal of the rejections under 35 USC §102(e) of claims 3 and 38 is respectfully requested.

Rejections under 35 USC § 103 traversed

Claims 3 and 38 stand alternatively rejected under 35 USC §103(a) as being unpatentable over Jankowski et al., 2003/0039874. These rejections are respectfully traversed. The Examiner has stated that "if the claims are not anticipated the claims are obvious as it has been held similar products claimed in product-by-process limitations are obvious" and cites various cases. Such a statement does not constitute a proper *prima facie* case of obviousness for a rejection under 35 USC §103. No proper *prima facie* case of obviousness has been made for these claims. There is nothing in the

record to show that the *differences of the limitations* of claims 3 and 38 from the teaching of Jankowski et al. as discussed above would be obvious at the time the invention was made to a person of ordinary skill. Therefore, withdrawal of the obviousness rejections of claims 3 and 38 is respectfully requested.

Claims 1, 4, 5, 7, 9, 16, 17, 28 – 37, 40, and 41 also stand rejected under 35 USC §103(a) as being unpatentable over Jankowski et al., 2003/0039874. These rejections are respectfully traversed. The reasons presented by the Examiner (page 11 paragraph 22) for the obviousness rejections of claims 1, 16, 17, 36, and 37 are similar to the reasons for the rejections of claims 3 and 38 under 35 USC §102, traversed hereinabove, including the mistaken interpretation of fuel inlet 15 and oxidant inlet 17 as "chambers." As pointed out above, these structures of Jankowski et al. do not have the limitations of the chambers recited in claims 1 and 36. Similarly, the three different substrates 11, 14, and 16 of Jankowski et al., which serve different purposes, do not fairly correspond to the single substrate recited in claims 1 and 36 and their dependent claims.

These differences between the prior art and the claims at issue are directly pertinent to the question of obviousness, and apply equally to dependent claims 4, 5, 7, 9, 28 – 35, 40, and 41. Regarding claims 16 and 37, Applicants respectfully submit that these dependent claims properly recite narrower scope than their parent claims, and no evidence has been presented that they are obvious in view of Jankowski et al. or any other prior art of record. Applicants respectfully submit that the Examiner has not shown a proper prima facie case of obviousness of claims 1, 4, 5, 7, 9, 16, 17, 28 – 37, 40, and 41. Therefore, Applicants respectfully request withdrawal of these rejections under 35 USC §103.

Claims 2 and 39 stand rejected under 35 USC §103(a) as being unpatentable over Jankowski et al., 2003/0039874 and further in view of Sasahara et al., 2002/0012825. These rejections are respectfully traversed. The Examiner states that it would have been obvious to provide the step of patterning the electrolyte of Jankowski et al. as taught by Sasahara et al. The

motivation cited by the Examiner for this combination is to provide very precise feature definition and to achieve significantly enhanced volumetric power density when compared with conventional fuel cells. However, the combination postulated by the Examiner would not make Applicants' invention as claimed in claims 2 and 39. Patterning the electrolyte of Jankowski et al. using any method disclosed by Sasahara et al. would still result in a structure that failed to have the features defined by all the limitations of parent claims 1 and 36, viz., specifically the "chamber including at least one *integral manifold*" as claimed in parent claim 1 or either of the first and second chambers each including an *integral manifold* of parent claim 36. Therefore, Applicants respectfully request that the rejections under 35 USC §103 of claims 2 and 39 be withdrawn.

The Examiner has included a note (page 13) that "The recitation 'adapted to' or 'adapted for' clauses are examples of claim language that may raise a question as to the limiting effect of the language in a claim." Applicants respectfully note that, as required by the previous examiner, every recitation of an "adapted to" or "adapted for" clause in this application includes at least one manipulative limitation clearly defining the respective adaptation.

This response is believed to be fully responsive to each issue raised in the office action, but if the Examiner maintains any rejection, applicant would appreciate a more detailed explanation of precisely where in the references the combination is suggested and the relevant limitations are disclosed.

Applicants expressly reserve the right to file divisional and/or continuation applications with any of the canceled or non-elected claims, or with similar claims, or with claims to any subject matter disclosed in the present application or incorporated by reference.

Applicants believe that the claims as amended are patentable over the prior art and respectfully request that the rejections be withdrawn and the claims allowed.

Attorney Docket No. 10019358-1; Ser. No. 10/628,946

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